Type of presentation: Poster

MS-3-P-2988 Hydrogen exposured to microstructure of Er_2O_3 coating layer prepared by MOCVD process

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In breeding blanket system of nuclear fusion reactor needs to development advanced type of coating to leak control of tritium and reducing magneto hydrodynamic (MHD) pressure drop. In breeding blanket system, material needs to fulfill five conditions. 1. Not break down at high temperature. 2. Low reactivity with Li as a coolant. 3. High electrical resistivity. 4. High permeation control of tritium. 5. High electrically insulating coating of 2μm or more. It has been reported that Er_2O_3 is excellent electrical resistance and a permeation control effect from various ceramic materials[1]. Hishinuma et. al. succeeded in forming Er_2O_3 film by metal organic chemical vapor deposition (MOCVD) process as a new technology for large area coating on broad and complicated shaped components[2]. MOCVD process is a concise procedure to form homogeneous and large area coating layer synthesized from a metal organic complex. Two stainless steel 316 (SUS316) disk plates were used in this work. SUS316 plates were coated with Er_2O_3 film using MOCVD process at 773K for 2 hrs. One was performed permeation of hydrogen with irradiation of the gamma ray after Er_2O_3 coating, and the other was hydrogen permeation test. XRD analysis with θ-2θ scan mode were carried out on a Philips X'pert system diffractometer using Cu Kα X-Ray irradiation. Scanning Electron Microscope (SEM) operating at 20keV with EDS and SLEEM mode were carried out on a HITACHI S-3500H. TEM sample for cross sectional observation were prepared by Focus Ion Beam (FIB) method (FB-2100, HITACHI) operating at 40keV using gallium ion. Transmission electron microscope (TEM) was carried out on a TOPCON EM-002B operating at 200keV with EDS. Fig. 1 shows the surface morphology of Er_2O_3 film before hydrogen permeation test and that surface had granular structure. Crystallines on the surface had various size and they look like line up by vapor flow. Fig. 2 shows TEM bright field image obtained for the sample prepared from central part of Fig. 1 by FIB method. There is no gap between Er_2O_3 and SUS substrate. Columnar grains of Er_2O_3 were corresponding to SEM image of granular structure in Fig1. SAED patterns obtained from Er_2O_3 of the sample before hydrogen permeation test was indexed as $[001]_{Er2O3}$. It can be understood that the growth direction (upper-bottom direction in Fig.2) of Er_2O_3 film was [110] by analysis of this SAED pattern.

[1] B.A.Pint , P.F.Tortorelli , A.Jankowski , J.Hayes , T.Muroga , A.Suzuki , O.I.Yeliseyeva , V.M.Chernov : J.Nucl.Mater 329-333 (2004) 119-124

[2] Yoshimitsu Hishinuma , Tsutomu Tanaka , Teruya Tanaka , Takuya Nagasaka , Yuzo Tasaki , Akio Sagara , Takeo Muroga : Fusion Engineering and Design 86 (2011) 2530-253

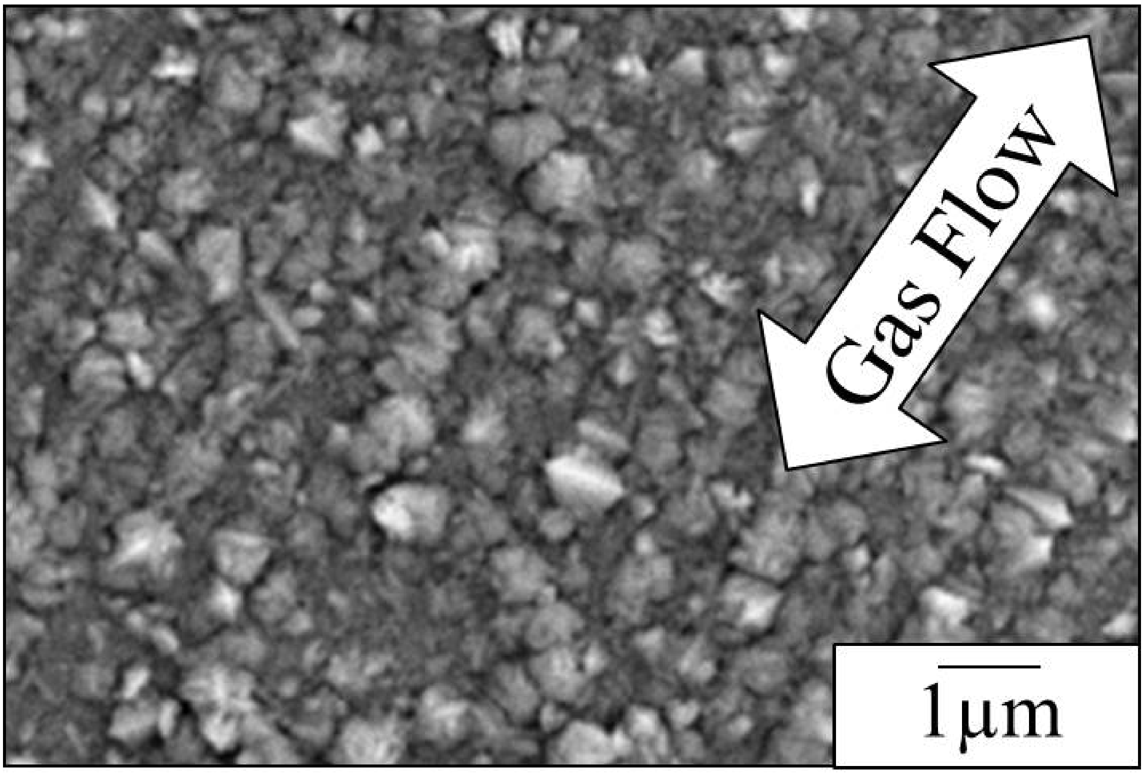

Fig. 1: SEM images of surface Er_2O_3 film before hydrogen permeation test

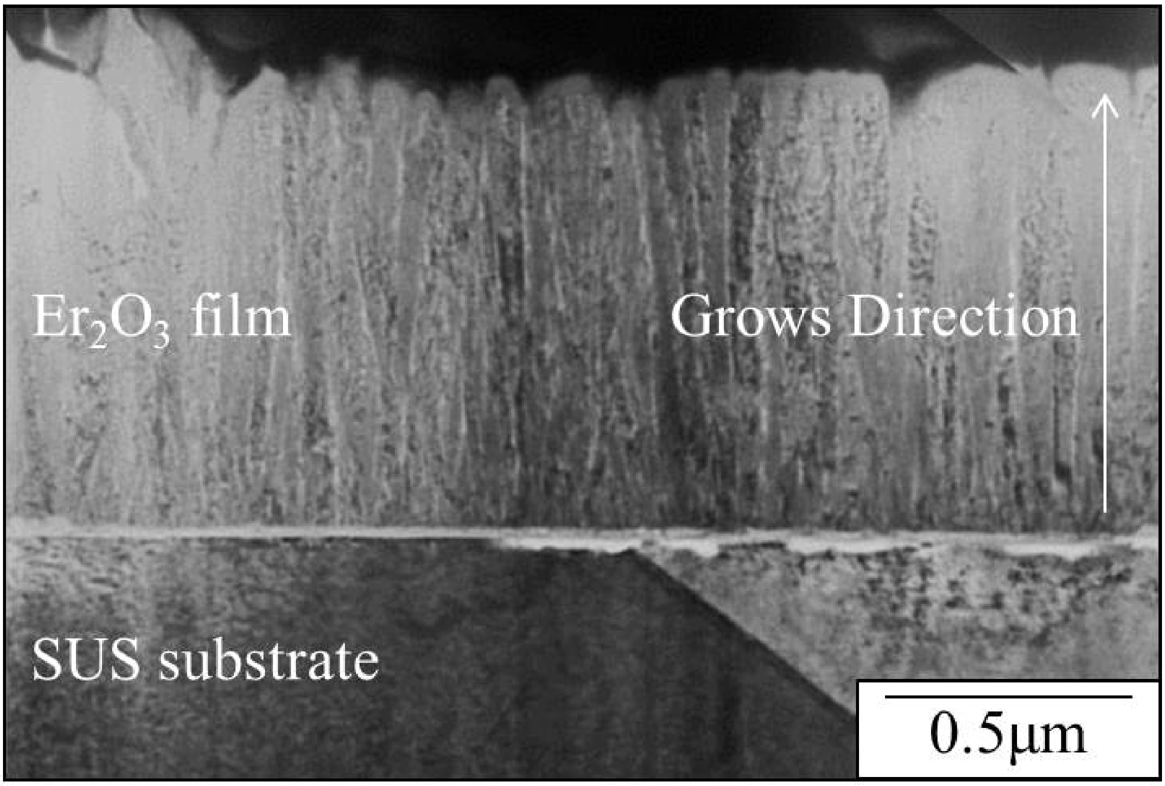

Fig. 2: Cross-sectional TEM bright field image of Er_2O_3 film before hydrogen permeation test